Reserves and Portfolio Management: A Language that Communicates to the Investment Community

Investor's view of reserves & resources reporting, Part 2

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Contents & Main Messages

- Framing the ‘Good, Bad & Ugly’ of Valuations
- Stock Portfolios Vs E&P Portfolios
- Estimating
  - Problems & impact
- Probabilistic Vs Deterministic
  - Aggregation & Theory of Inevitable Disappointment
- Outcomes & Calibration
  - Real portfolios & examples
FRAMING
Decision Making

With a few differences in detail, we can view & value a Portfolio of Upstream assets the same way we view & value a personal investment portfolio:

- Requires management to steer towards required outcome
- Poor estimating
- Wrong decision tools

\[ 2 + 2 = 4 \]
\[ 2 + 2 + a = x \]
\[ 2 - 2 = 4 \]
Economic Limits – Good, Bad and Ugly

The Good: Economic Limit testing is a useful tool to indicate when net operating cash flow is no longer positive, and hence constrain future production forecasts/revenue to the ‘economic’ volumes. PRMS states:

- Economic limit is defined as the production rate beyond which the net operating cash flows from a project, which may be an individual well, lease, or entire field, are negative, a point in time that defines the project’s economic life.

The Bad: Economic limits may not necessarily be consistent with commercial decision making or optimizing targets under specific fiscal regimes as they ignore abandonment costs and income tax liabilities, even though these are real and often material cash outflows.

The Ugly: An operator may choose to produce for some time after economic limit:

- if it considers future prices will enable a return to positive cash flow.
- if it intends further development or remedial actions to increase production.

- Estimating
- Forecasting
- Decision Making
- Subjectivity & Data/Information
Commercial Determination – Lenders Caveat

- PRMS guidelines do not require that project financing be confirmed prior to classifying projects as Reserves.

- In many cases, loans are conditional upon the project being economic based on Proved (1P) Reserves only: Reserves Based Lending (RBL).

- If financing is reasonably expected, but not yet confirmed, and financing is an external requirement for reporting in that jurisdiction, the project may be internally classified as Reserves (Justified for Development), but no Proved Reserves may be reported.

- If there is not a reasonable expectation that loans or other forms of financing (e.g., farm-outs) can be arranged such that the development will be initiated within a reasonable time frame, then the project should be classified as Contingent Resources.

Source = PRMS 2011 : Section 7.3 Definitions of Essential Terms, Financing
PORTFOLIOS
Portfolio Effect

E&P projects versus stock market returns

Portfolio Effect of predictability of multiple prospects/projects

- Normal
- Main Risk is Volatility

- Lognormal
- Risk of Total Loss
Stock Portfolios Vs E&P Portfolios

E&P is Driven by Unusual Events

Balanced Stock Portfolios

S&P 500 Index, 1987-2005

MEAN = 0.9% / month

Monthly Return (%)

Frequency

Finite E&P Portfolios

NYSE Expl. Portfolio

Crystal Ball® Model

Tell this to market

MOST LIKELY OUTCOME for a SINGLE YEAR

MEAN OUTCOME

Hope for this

P90

P10

MMBboe
We believe that Newfield's plan to acquire $575 million of Rocky Mountain assets from Stone Energy will have a neutral impact on NFX's share price in near term trading.

Newfield has struggled to grow production -- its large GOM asset base and execution issues have perhaps encouraged it to re-deploy capital into lower-risk regions. The Pinedale and Jonah Field assets are very high quality assets with strong drilling economics (assuming that current weak Rocky Mountain prices recover).

- The transaction should help to improve the overall quality and predictability of Newfield's asset base and lengthen its reserve life from 8.1 to 8.3 years (using pro-forma year end 2006 reserves divided by 2008E production).
ESTIMATING
Question: When does $2 + 2 = 5$?

Answer:

When Excel decimal places = 0

$2.4 + 2.4 = 4.8$  $2 + 2 = 5$

Engineer risk = 36.47%

Economist risk = 0.365

Geologist risk = 35%

Finance manager = £ which number?
E&P Project Cost Overruns:
25 major projects since year 2000

FID to RFSU Avg. Overrun: 10 months (23%)
1 project (Darwin LNG) came in on schedule

Targeted FID date to actual FID date for ten Australian LNG projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Operator</th>
<th>Target FID</th>
<th>Actual FID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pluto 1</td>
<td>Woodside</td>
<td>2007</td>
<td>August 2007</td>
</tr>
<tr>
<td>Gorgon 1-3</td>
<td>Chevron/Exxon/Shell</td>
<td>2004/2008</td>
<td>September 2009</td>
</tr>
<tr>
<td>QC LNG</td>
<td>BG Group</td>
<td>Early 2010</td>
<td>November 2010</td>
</tr>
<tr>
<td>GLNG</td>
<td>Santos/Petronas</td>
<td>Mid 2010</td>
<td>January 2011</td>
</tr>
<tr>
<td>APLNG (Train 1)</td>
<td>Origin/CoP</td>
<td>End 2010</td>
<td>July 2011</td>
</tr>
<tr>
<td>Wheatstone</td>
<td>Chevron</td>
<td>End 2011</td>
<td>September 2011</td>
</tr>
<tr>
<td>Ichthys</td>
<td>Inpex/Total</td>
<td>End 2010</td>
<td>January 2012</td>
</tr>
<tr>
<td>APLNG (Train 2)</td>
<td>Origin/CoP</td>
<td>End 2011 to Early 2012</td>
<td>July 2012</td>
</tr>
<tr>
<td>Browse</td>
<td>Mid 2012</td>
<td>TBA</td>
<td></td>
</tr>
</tbody>
</table>
Impact of Poor Estimating

NPV gained (or lost) after two years of production relative to plan at sanction

70% of projects had lower NPV than forecast at FID
Average NPV = 41% lower than planned

10 year sample

Reasons for NPV loss of 60 well programme

1) Poor estimate of inputs
2) Inappropriate project ‘shaping’ i.e. wrong development for the resource
3) Confusing accuracy with confidence as information increases
4) Believing sophistication reduces risk
5) Under-estimation of time to complete tasks
6) Scope changes: poor definition, lack of rigor in approval process
7) Ignoring dependencies and inter-dependencies
8) Poor risk management: Lack of contingency, ineffectual contractual protection

North Sea Oil Production 1996 v 2006
Value gained after ten years of production relative to plan at sanction
PROBABILISTIC Vs DETERMINISTIC
Aggregation of Reserves

PRMS 2011 “....If we stick to arithmetic aggregation of Proved Reserves, we run the risk of systematically underestimating the value of the combined assets..... this can be avoided (with probabilistic tools & methods).....”

Understanding range of Uncertainty:
1) Deterministic
2) Scenario Method
3) Probabilistic Method

PRMS 2011 “....Oil companies, considering long-term performance of assets....work on the assumption that in the long run, the portfolio of their best estimates will be realized, with the downside in one case compensated for by the upside in another situation.....best practice that ..... where assessments are based on deterministic methods, summations are arithmetic and by category.

Where probabilistic assessments are available, companies may aggregate probabilistically to the field/project level but subsequent summations are generally arithmetic......for internal portfolio analyses, companies may use fully probabilistic methods......”
Portfolio Theory vs Reality (Deterministic & Probabilistic)

1. Prospect Identified

2. Probabilistic Risk and Resources Calculated with Standard Software

3. Peer Review Meeting

4. Compare to Portfolio

5. Prospect Technically Mature

EMV > 0
Drill

EMV < 0
Reject
Recycle
Drop

*Markowitz (1959)
Definitions & Distributions

Hydrocarbon Resource Distributions are typically Log Normal

So what goes into EMV calculation?

Central Limit Theorem

- **EMV** = (Chance of Success x NPV) – (Chance of Failure x Cost of Failure)
- **EMV** is a good tool but not understood
- ‘*Estimated*’ or ‘*Expected* = Most Likely = Mode
- Used as hurdle to accept/reject BUT used incorrectly most of time : WHY?
- Decisions need to understand whole distribution, not just one point
- Theory of Inevitable Disappointment (Horner, 1982) highlights inadequacy of using EMV and not considering whole distribution
Theory of Inevitable Disappointment

Actual performance of portfolio of assets will inevitably be worse than predicted

- Assume perfectly unbiased prediction with dispersion
- Projects chosen for investment in portfolio based on predicted or expected value

Horner (1982)
The Theory of Inevitable Disappointment

Actual performance of portfolio of assets will inevitably be worse than predicted

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![Diagram showing frequency of actual rate of return vs. rate of return with threshold value for project inclusion. Outcomes below threshold, but projects were chosen for portfolio based on predicted value.](Horner (1982))
• Equally there will be portfolio outcomes above the ‘company hurdle rate’/threshold
Theory of Inevitable Disappointment

- Equally there will be portfolio outcomes above the ‘company hurdle rate’/threshold
Modelling of 255 ‘Normal’ projects

Portfolio predicted Rate of Return = 27%

Actual outcome Rate of Return = 18%
OUTCOMES & CALIBRATION
Bajcsa gas field, Hungary

- RBL @ 1P (Proved)
- 2P Development Capital
- Focus Vs ‘All eggs in one basket’
- Diversified Vs Unfocussed
NYSE Listed: Exploration Valuation

Onshore, Gulf of Mexico, USA

Prospect 1
Prospect 2
Prospect 3
Prospect 4
Prospect 5
Prospect 6
Prospect 7
Prospect 8
Prospect 9
Prospect 10
Prospect 11
Prospect 12
Prospect 13
Prospect 14

Cumulative Value

>90% of Total Predicted MMBoe

1 Year

Prospect 1
Prospect 2
Prospect 3
Prospect 4
Prospect 5
Prospect 6
Prospect 7
Prospect 8
Prospect 9
Prospect 10
Prospect 11
Prospect 12
Prospect 13
Prospect 14
Suggestions to Improve Decision Making

- Whilst Economic limits are a common industry metric, PRMS defines the limit in cash flow terms rather than value terms.
- Production beyond the economic limit does not necessarily imply reclassifying of reserves under the PRMS, although......
- ‘Short period of low pricing’ and ‘reasonable price forecasts’ to justify ongoing production below the Economic Limit are unclear.

RISC has evaluated hundreds subsurface (reserves and resources) & surface (costs and schedule) projects over twenty years.

- Same mistakes keep being made and repeated – We learn but also forget.
- Recognise “black swan” events & make allowance with contingency.
- Be wary of over confidence & experts: use genuinely independent peer reviewers.
- Be aware of culture of many organisations that suppresses uncertainty & reward behaviour that ignores it (e.g. an executive who shows greater confidence in a plan is more likely to get it approved than one who lays out all the risks and uncertainties).
- Learn from previous experience (feedback/post-mortems), **calibration is KING**.
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